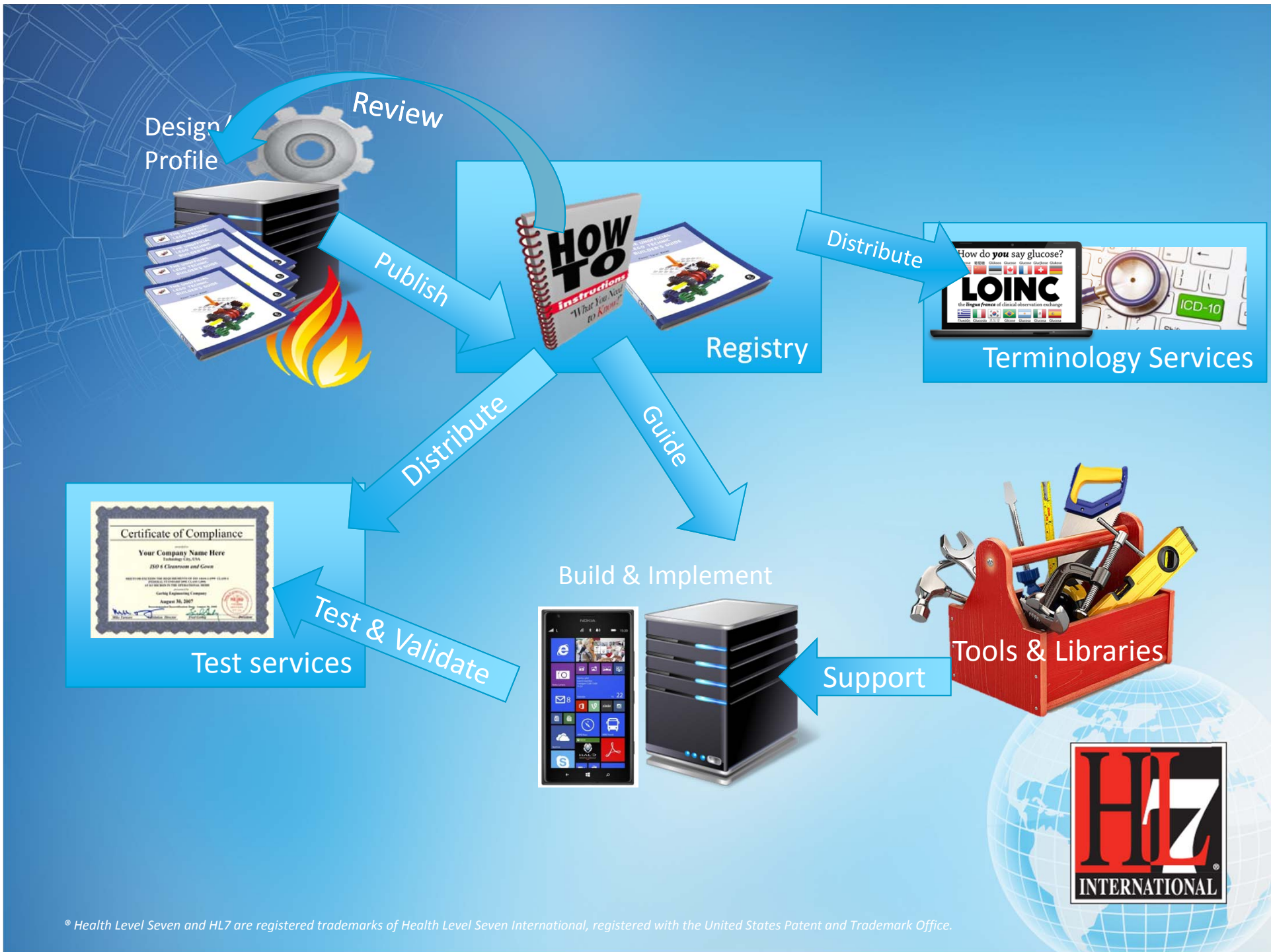


# FHIR Tooling and Ecosystem



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## Design/Profile (conformance resources)

- Goal: Support creation of FHIR “profiles”, valuesets and other *conformance resources*
- Forge – visual editor for profiles
- Trifolia – CDA templates + FHIR profile editor
- Notepad++ extension – “FHIR toolkit”
  - ValueSet, CodeSystem, CapabilityStatement



### Session Explorer

New Open Save Remove

- Session
  - MyObservation

### File Properties

Title: MyObservation

Type: Constraint

Filename: (new)

Location: (new)

Last modified: Thu, 01 Mar 2018 10:57:17 GMT

## Profile on Observation<sup>(5)</sup>: MyObservation



Properties Narrative Element Tree Element Grid Xml

Extend Slice Add Slice

- Observation
  - identifier (\*)
  - basedOn (\*)
  - status (1)**
  - category (\*)
  - code (1)
  - subject
  - context
  - effective[x]
  - issued
  - performer (\*)
  - value[x]
  - dataAbsentReason
  - interpretation
  - comment

### Element Properties: status (1)

Element ID: Observation.status

Cardinality: 1 ... 1 0..0 0..1 0..\* 1..1 1..\*

Type(s) Profile

code

Valueset binding

Fixed value

Short description: registered | preliminary | final | amended +

Definition: The status of the result value.

Observation / URL The canonical resource url 'StructureDefinition/MyObservation' is invalid and not suitable for publishing purposes. A canonical url should be absolute ;





# Publish (Implementation Guide)

- HL7 IG Publisher
- Simplifier IG Editor
- Trifolia IG export

```
<CapabilityStatement xmlns="http://hl7.org/fhir">
  <id value="server"/>
  <kind value="requirements"/>
  <fhirVersion value="3.0.0"/>
  <acceptUnknown value="extensions"/>
  <format value="xml"/>
  <format value="json"/>
  <profile>
    <extension url="http://hl7.org/fhir/us/core/StructureDefinition/
      <valueCode value="AllergyIntolerance"/>
    </extension>
    <reference value="http://hl7.org/fhir/us/core/StructureDefinitio
      <display value="US Core AllergyIntolerance Profile"/>
    </profile>
  <rest>
    <mode value="server"/>
    <resource>
      <extension url="http://hl7.org/fhir/StructureDefinition/capabi
        <extension url="required">
          <valueString value="name"/>
        </extension>
        <extension url="required">
          <valueString value="gender"/>
        </extension>
      </extension>
    </extension>
  </extension>
  <extension url="http://hl7.org/fhir/StructureDefinition/capabi
```

## Resource Details:

### 1. Patient

Supported Profiles: US Core Patient Profile

#### Search Criteria:

1. A server **SHALL** be capable of returning a patient using:

`GET [base]/Patient/{id}` .

1. A server **SHALL** be capable of returning a patient by identifier using:

`GET [base]/Patient?identifier={system}|{code}`

1. A server **SHALL** be capable of returning a patient by supporting

- name
- gender
- birthdate

- for example:

`GET [base]/Patient?name={name}&gender={gender}`

#### Search Parameters:

Conformance	Parameter	Type
SHALL	name	string
SHALL	identifier	token
SHALL	family + gender	string + token
SHALL	given + gender	string + token
SHALL	name + gender	string + token
SHALL	name + birthdate	string + date



# Publish (to registry.fhir.org)

The screenshot displays the SIMPLIFIER.NET web interface. At the top, there is a navigation bar with the SIMPLIFIER.NET logo, a search bar, and links for SNIPPET, FEEDBACK, and a user profile icon. Below the navigation bar, the main content area is titled 'Start publishing' and includes a sub-header: 'Choose or create a project and upload your FHIR resources. In the project settings, you can choose to publish to other registries like registry.fhir.org'. The interface is divided into three numbered steps:

- 1 Log In or Sign Up**  
You are signed in.
- 2 Select a project**  
A dropdown menu is shown with 'Ewout's Projects' selected.
- 3 Upload a resource**  
A file upload area with a 'Select file' button and an 'Upload' button.



## | Registry

- **Goal: Find & retrieve published profiles and guides – worldwide!**
- **Access for humans (UI) and systems (API)**
- **registry.fhir.org**
- **simplifier.net**





# Registry



SIMPLIFIER.NET



Search published

PROJECT Finnish PHR AllergyIntolerance profile

## Finnish PHR Allergy Intolerance profile

Profile

507 results

type Profile on AllergyIntolerance FHIR STU3 status Draft version none experimental Canonical http://phr.kar

STRUCTUREDEFINITION  
<http://hl7.org/fhir>

XML JSON

SHOW NARRATIVE

Overview



SIMPLIFIER.NET

SNIPPET FEEDBACK

Name

- AllergyIr
- identi
- clini
- verifi
- type
- categ
- critic
- code
- patier
- onset
- assert
- record

Search Type

- Resources
- Projects
- Organizations

Fhir Version

or not

- DSTU2
- STU3

Resource Categories

- or not
- Profiles
- ValueSets

### HCIM Medication Agreement ★ 2

Profile on MedicationRequest  
Project: Nictiz STU3  
This profile is based the Dutch Health and Care Information models (Dutch: Zorginformatiebouwsteen or ZIB) nl.zorg.MedicatieAfspraak version 1.0, year 2017.

14-12-2017

Active

### HCIM AllergyIntolerance ★ 1

Profile on AllergyIntolerance  
Project: Nictiz STU3  
An AllergyIntolerance resource as defined by the Dutch Health and Care information models (Dutch: Zorginformatiebouwsteen or ZIB) version 1.0

31-1-2018

Active

### HCIM Medication Administration ★ 1

Profile on MedicationAdministration  
Project: Nictiz STU3  
This profile is based the Dutch Health and Care Information models (Dutch: Zorginformatiebouwsteen or ZIB) nl.zorg.MedicatieToediening version 1.0, year 2017.

7-12-2017

Active

### HCIM Medication Use ★ 1

Profile on MedicationStatement  
Project: Nictiz STU3  
This profile is based the Dutch Health and Care information models (Dutch: Zorginformatiebouwsteen or

7-12-2017

Active



# To summarize: For the authors...



# Terminology Services

- Goal: provide standardized access to valuesets and codesystems
- Implement FHIR TerminologyService sub-API:

Looking up a code in a code system:

```
GET [base]/CodeSystem/loinc/$lookup?code=1963-8
```

Test whether a SNOMED CT Concept 'Disorder of liver' (235856003) subsumes 'Viral hepatitis' (3738000):

```
GET [base]/CodeSystem/$subsumes?system=http://snomed.info/sct&codeA=235856003&codeB=3738000
```

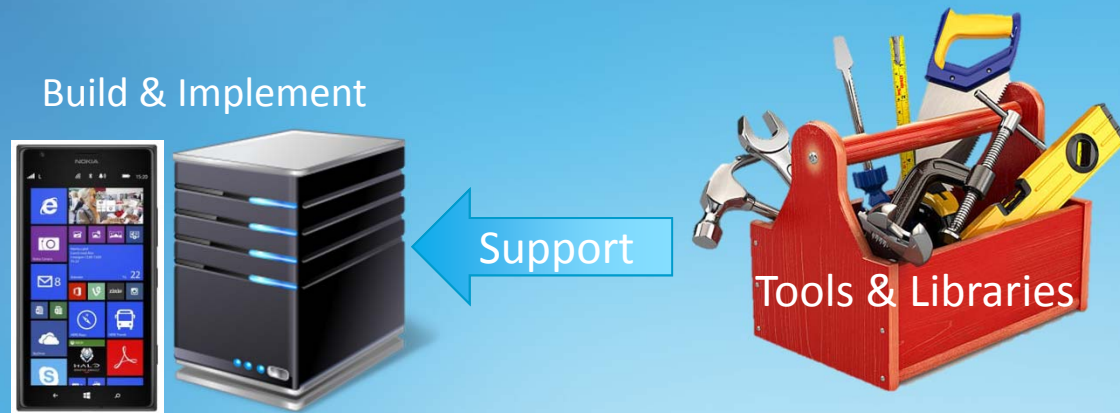


## | Terminology Services

- [tx.fhir.org](http://tx.fhir.org)
- Terminz
- Apelon
- CSIRO's Ontoserver
- NLM Fhir services on VSAC
- Art-Decor
- Health Language FHIR terminology services



# Software Developers



- FHIR client libraries
- FHIR server frameworks
- Instance editing and generation



## | FHIR Client libraries

- Pre-built libraries to create FHIR clients quickly
- Implement FHIR REST protocol
- Parsing and serialization
- Validation



## | FHIR Client libraries

- Java HAPI
- .NET FHIR API
- fhir.js
- Meteor on FHIR (Javascript)
- Health Intersections Delphi
- Swift-FHIR



## | FHIR Server Frameworks

- “Starter-kit” to build a FHIR server with
  - Handle HTTP calls, operations, FHIR search syntax
  - Connect to your data:
    - Use relational storage (as blob)
    - Document dbs (e.g. MongoDB)
    - Facade to existing database





# FHIR Server frameworks

- Health Intersections FhirServer
- SmileCDR - HAPI (Java)
- Firely Vonk (.NET)
- Aidbox.io
- AEGIS WildFHIR
- open.epic.com
- fhir-open.sandboxcerner.com

More at:

[http://wiki.hl7.org/index.php?title=Publicly\\_Available\\_FHIR\\_Servers\\_for\\_testing](http://wiki.hl7.org/index.php?title=Publicly_Available_FHIR_Servers_for_testing)



# Edit FHIR instances

Patient Viewer Roman Wang male 1956-12-10 (12991) Select Patient

Resource explorer Resource references graph Numeric Observations/Vitals Encounter timeline FHIRPath Documents Questionnaires

```
Tree Text Json
List
  resourceType List
  id 12992
  meta
    versionId 1
    lastUpdated 2018-03-02T17:00:15.927-05:00
  status current
  mode snapshot
  title Problems List
  code
    coding
      [0]
        system http://hl7.org/fhir/list-example-use-codes
        code problems
  subject
    reference Patient/12991
  date 2018-03-02T14:00:08-08:00
  entry
    [0]
      date 2018-03-02T14:00:08-08:00
      item
        reference Condition/12993
    [1]
      date 2018-03-02T14:00:08-08:00
```

Note that the Patient is not displayed in this graph.



# Generating FHIR instances

SyntheticMass

[Home](#) [SyntheticMass Dashboard](#) [Download](#) [FHIR API](#) [About This Project](#) [Feedback](#)

## SyntheticMass

Visualize and Interact with synthetic patient and population health data that simulates the state of Massachusetts in 2021.



[View SyntheticMass Dashboard](#)

## About SyntheticMass

SyntheticMass is an open-source, simulated Health Information Exchange (HIE) populated with realistic "synthetic residents" of Massachusetts.

SyntheticMass provides:

- Population health and demographic data at the city and town level
- The ability to drill down to individual synthetic patient data
- Fictional but realistic data representing synthetic patients
- APIs and Data Services such as Direct, FHIR and CCDA

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Approved for Public Release; Distribution Unlimited. Case Number 16-2027

 MITRE



# Testing your FHIR software



Test services

Build & Implement



- Testing FHIR data (“validation”)
- Testing your service’s FHIR API (conformance testing)



# Instance validation

- Goal: Give determinative “valid”
- Much I
- Java tool (http://h
- Simplified
- .NET API (https://c
- r.Validation

The screenshot shows the .NET Profile Validation Tool 1.4 (STU3) interface. The main window displays an XML instance for validation. The XML content is as follows:

```
<?xml-model href="http://hl7.org/fhir/STU3/medicationdispense.sch" type="application/xml" schematypens="http://purl.oclc.org/dsdl/schematron"?>
<MedicationDispense xmlns="http://hl7.org/fhir" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://hl7.org/fhir
http://hl7.org/fhir/STU3/medicationdispense.xsd">
  <id value="AdministrationAgreement-example" />
  <meta>
    <profile value="http://nictiz.nl/fhir/StructureDefinition/zib-AdministrationAgreement" />
  </meta>
  <extension url="http://nictiz.nl/fhir/StructureDefinition/zib-AdministrationAgreement-AuthoredOn">
    <valueDateTime value="2012-09-11T13:21:42+01:00" />
  </extension>
  <extension url="http://nictiz.nl/fhir/StructureDefinition/zib-AdministrationAgreement-ReasonForDispense">
    <valueString value="Patient request for different product" />
  </extension>
  <status value="completed" />
</MedicationDispense>
```

Below the XML, the 'Last Validation results' section shows an overall result of FAILURE. The error message is: [ERROR] Encountered unknown child elements 'value', 'unit', 'system', 'code' for definition 'Dosage.dose[x]' (at MedicationDispense.dosageInstruction[3].dose[0]).

The 'Settings' section includes the following options:

- Trace information
- Xsd validation
- Disable FhirPath checks
- Regenerate snapshots

Path to definitions: C:\git\Nictiz-STU3 + core specification  
Terminology servers: Built-in terminology service

Buttons: Change..., Reload Definitions

Status bar: [17:22] Validation finished in 2360 milliseconds



## | Testing

- **Goal: Run fhir TestScripts on your endpoint and analyze your compliance**
- **Aegis TouchStone**
- **MITRE Crucible**



# Testing - TouchStone

**Touchstone Project** | HL7 FHIR | Test Systems | Organizations | Users | Admin | Docs | Richard

Conformance Spec: FHIR 3.0.1 | FHIR-Server: AEGIS.net, Inc. - WildFHIR FHIR-3-0-1 | Exclude Unsupported in CapabStrm | Month: Mar 2018

**100% conformant**

**FHIR3-0-1-Connectathon17**

**FHIR3-0-1-Basic**

**FHIR3-0-1-Advanced**

FHIR 3.0.1 Interactions	100% passed	Total
440	100%	440
2,216	100%	2,216
382	100%	382

**FHIR 3.0.1 Interactions**

	100% passed	Total
Summary	100%	3,038
Operations	x	
Resources	x	3,034
WholeSystem	x	4

Legend:  
- Unsupported by the capability statement (light grey)  
- No test executions yet (dark grey)  
- 0 failures -> Increasing % of passes (green)  
- 1 or more failures -> Increasing % of failures (red)

**Test Scripts**

Execute Selected | Search: | Previous 1 2 3 4 5 ... 73 | Next

Test Script	Status	Start Time	Interactions
<input type="checkbox"/> /FHIR3-0-1-Advanced/Capabilities/fhir-api-stu3-capabilities-01-metadata FHIR API STU3 Advanced Operation Tests - Capability Metadata test suite against a single server to verify support for the capabilities interaction 'HTTP GET metadata' and the return of a valid CapabilityStatement resource.	Execute Passed	03/01/2018 02:26:19PM	
<input type="checkbox"/> /FHIR3-0-1-Advanced/Capabilities/fhir-api-stu3-capabilities-02-options FHIR API STU3 Advanced Operation Tests - Capability	Execute Passed	03/01/2018 02:26:28PM	

- Library of test scripts
- Scripts for each connectathon



# Become certified!



## HL7 FHIR® STU3

### HL7 FHIR STU3 Proficiency Exam Preparation

HL7 FHIR is the latest standard for exchanging healthcare information electronically based on current and emerging industry approaches and informed by HL7's long-term experience in the field of interoperability standards development. The HL7 FHIR STU3 Proficiency Exam allows test takers to demonstrate their understanding of the fundamental concepts of FHIR and their proficiency with the FHIR standard specification.

### HL7 FHIR (STU3) Proficiency Exam Tutorial

This tutorial is designed to assist students in their preparation for the HL7 FHIR STU3 Proficiency Exam. Students preparing for the exam are expected to study the HL7 FHIR STU3 Specification as recommended in the FHIR Proficiency Exam Study Guide.

The tutorial will benefit

- Anyone preparing for the HL7 FHIR STU3 Proficiency Exam
- Implementers seeking a detailed review of the fundamental components in the FHIR specification.
- Implementers seeking a detailed review of the fundamental components in the FHIR specification.





# FHIR Foundation



HL7 FHIR Foundation Enabling health interoperability through FHIR

[About fhir.org](#)

[Calendar](#)

[Home](#)

[Member Login](#)

## Navigation

- [Donations](#)
- [Implementation Registry](#)

## Welcome to the HL7 FHIR Foundation

Welcome to the HL7® FHIR® Foundation, the home for FHIR Implementers. FHIR (Fast Health Interoperability Resources) is an HL7 specification for Healthcare Interoperability.

### FHIR® Community Links

- [Where to find support for FHIR](#)
- [Public Community Forum](#)
- [FHIR Chat Channels](#)
- The FHIR standard is maintained by HL7 ([get involved](#))

### FHIR Implementation Links

- Registry of [Implementation Guides](#)
- Registry of [Implementations](#)
- Smart-on-FHIR [App Registry](#)
- FHIR Community Projects (coming)
- FHIR Reference Implementations (coming)

### FHIR Foundation Member Services

- Forums: [Foundation Forum](#) and [Market Place](#)
- [Monthly Status Reports](#)
- ★ [Become a Member Now](#)

### FHIR Implementation Support

- FHIR Trademark use applications for [Community](#) and [Product Use](#)
- [Conformance Testing](#)

[About fhir.org and the HL7 FHIR Foundation](#)

<http://fhir.org>



# Community support


Page: 1 2 3 4 5 6 .... 170 171 172 173 174 (4342 Total Records)

New Tracker Item


ID	Summary	Priority	Assignee	Submitted By	Ballot Resolution	Section number	Status
9777	<a href="#">BackboneElement specialization names need to be set to remove duplicate classnames in some of the code generation tools</a>	Medium	Nobody	Brian	None		Submitted
9776	<a href="#">Typo in Bundle references example</a>	Medium					
9775	<a href="#">Misspelled search parameter for ExplanationOfBenefit claimidentifier</a>	Medium					
9774	<a href="#">Create required core profile for Vital Sign</a>	Medium					
9773	<a href="#">Allow CommunicationRequest resource to have Group as a recipient</a>	Medium High					
9772	<a href="#">QA: Patient deathdate search parameter does not conform to style guide</a>	Medium					
9771	<a href="#">Two typos in one sentence</a>	Medium					

- Announcements
- argonaut
- cda to fhir
- cds-hooks 335
- clinFHIR 34
- committers 323
- conformance 62
  - Forge - ElementDefinition.b... 6
  - Simplifier - Icon 5
  - Fixing resource type for ref... 8
  - Implementation Guide with... 11
  - Conformance resource 18
  - Forge profile and build me... 6
  - Query re the Conformance ... 4
  - Profiling CodeableConcept 4
  - (more topics)
- dotnet
- hapi 7
- implementers 476
- javascript
- netherlands


conformance **Profiling CodeableConcept**

 **Michel Rutten**  
Hi Richard, I am not completely clear how to reproduce...  
I've created a profile on CodeableConcept and constr...


conformance **Query re the Conformance resource**

 **Josh Mandel**  
I continue to think that requiring custom generated a...  
not populate this field (or will populate it meaningles...

conformance **Forge**

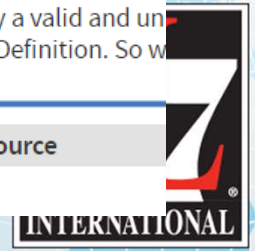
 **Michel Rutten**  
Note: Forge currently doesn't respond well to Structu...  
required, so you should always specify a valid and un...  
gracefully handle an invalid StructureDefinition. So w...  
don't do this ;p

conformance **Query re the Conformance resource**

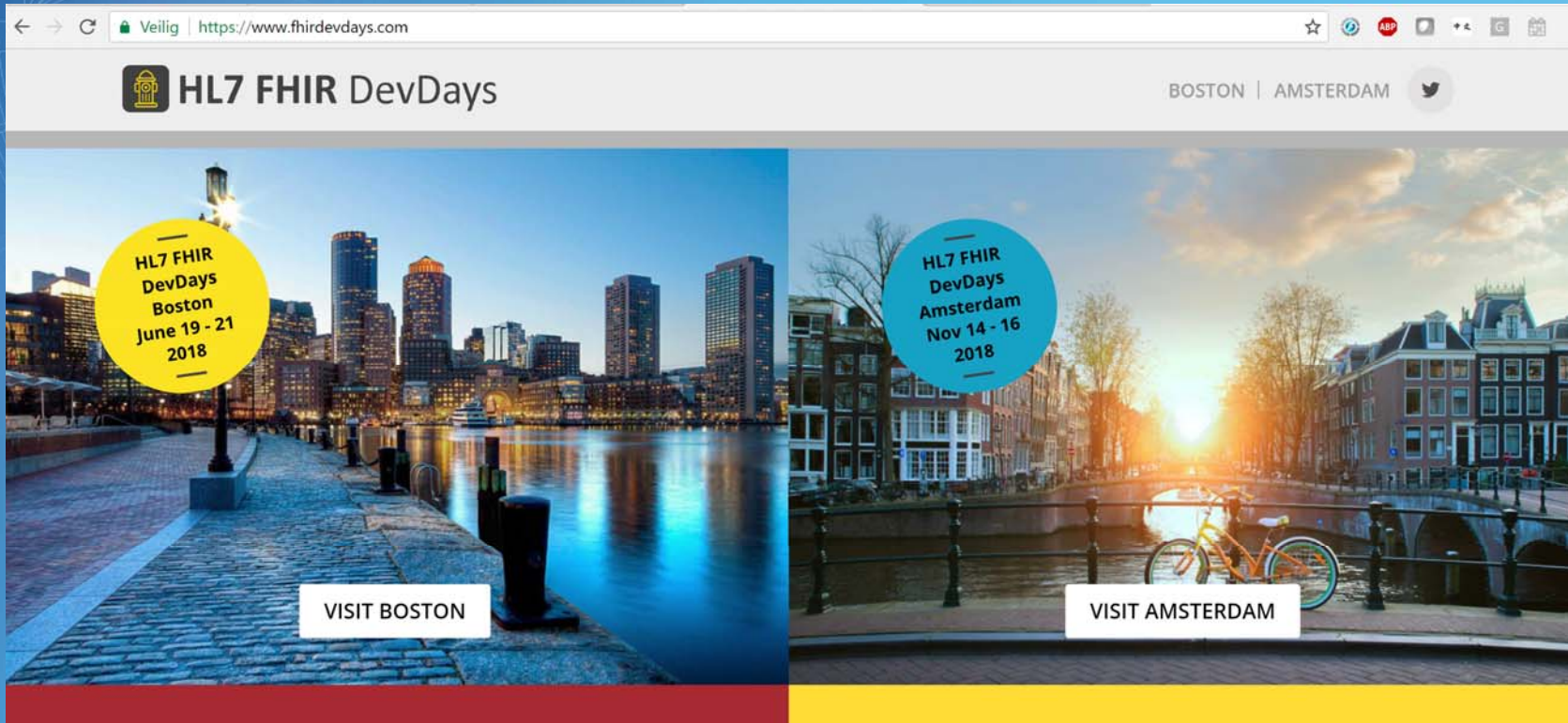
 **Grahame Grieve**

<http://bit.ly>

[chat.fhir.org](http://chat.fhir.org)



# HL7 FHIR DevDays



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web: <http://blog.fire.ly>  
skype: ewoutkramer

